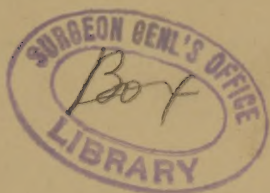
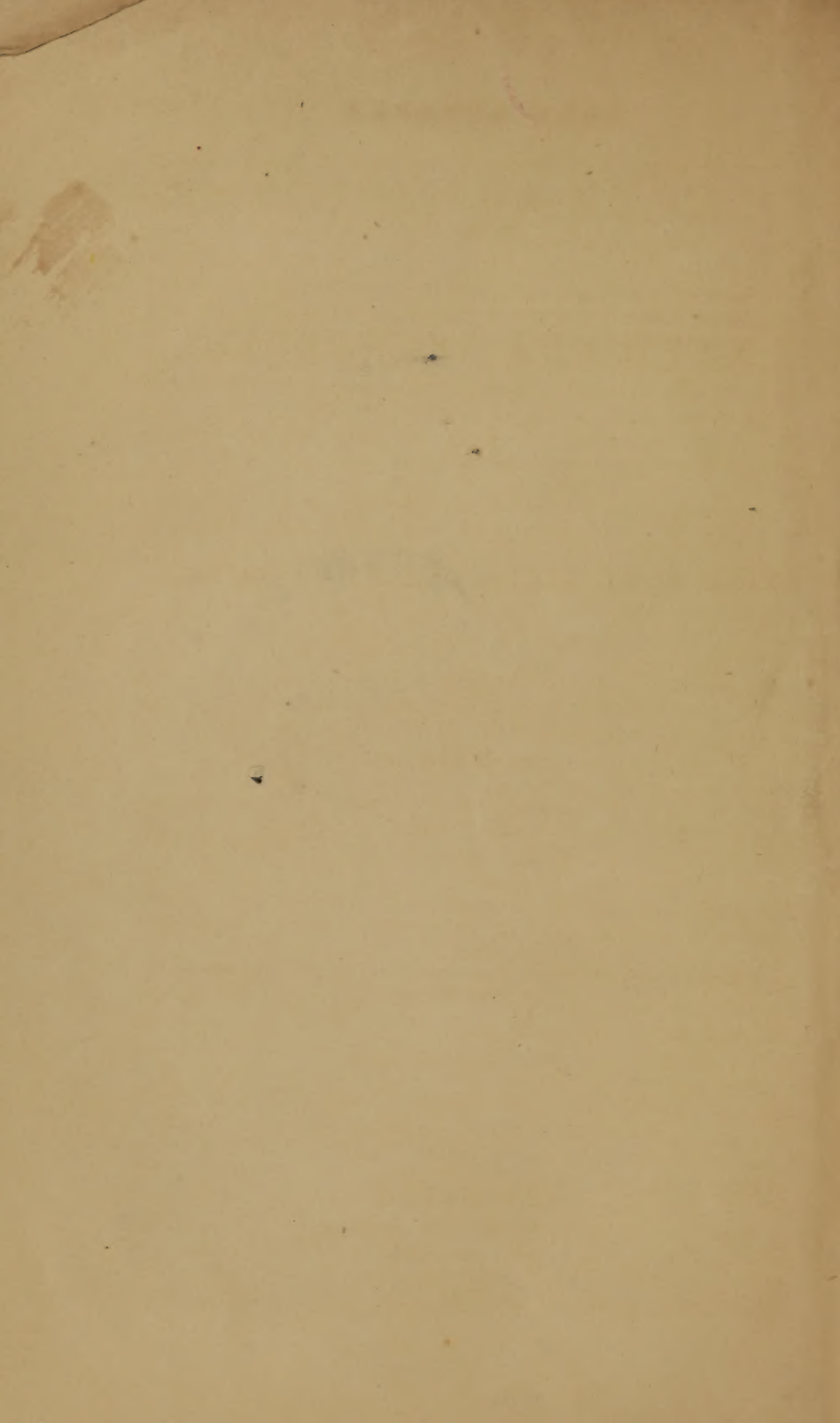


Bailey (J.W.)

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navicula spencerii x x x





SOME REMARKS

ON THE

NAVICULA SPENCERII,

AND ON A

STILL MORE DIFFICULT TEST OBJECT.

BY

J. W. BAILEY. ✓

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REMARKS, &c.

I HAVE learned from several quarters, that the notice of the new test object to which I gave the name *Navicula Spencerii* contained in Quekett's Practical Treatise on the Microscope recently published, has given rise to most erroneous impressions which justice to all concerned requires me to correct as far as is in my power. The work alluded to has not yet reached me, but I am indebted to a friend for the 8th and 9th plates, and the following extract referring to the test in question.

Navicula Spencerii.—Early in the present year, Mr. Matthew Marshall received some specimens of this species from Professor Bailey, of West Point, New York, who stated that an object-glass, constructed by a young artist of the name of Spencer, living in the back woods, had shown three sets of lines on it, when other glasses of equal power, made by the first English opticians, had entirely failed to define them. Mr. Marshall was supplied with the identical specimens on which Mr. Spencer's object-glass had been tried; these have since been carefully examined by Mr. Marshall and Mr. Warren De La Rue, and the nature of the markings clearly made out. Mr. De La Rue, has obligingly furnished the author with Plate IX, in which he has faithfully delineated a specimen of *N. Spencerii*, as viewed under a power of 800 diameters, and a portion of the same magnified 1,900 diameters, from which it will be plainly seen that the lines discovered by Mr. Spencer are in reality dots, and arranged so as to exhibit both transverse, longitudinal, and even oblique striæ, when viewed by an object-glass not capable of separating the dots one from the other. Mr. De La Rue has further made out that the dots are not projections from the surface, but are either perforations or depressions. The shape of the shell is not unlike that of a small kind of *N. Hippocampus*, which the markings also very much resemble.—p. 440.

The above notice is accompanied by a plate drawn by Mr. W. De La Rue representing the object as seen by him, magnified 800 diameters, and a figure of a portion of the same magnified 1900 diameters is also given to show the supposed perforations.

I believe the impressions which have been generally received by American microscopists, on the perusal of the above, are that it indirectly charges me 1st with underrating the English microscopes; 2d with over-rating both the merits of our own artist Spencer, and the difficulties of the *N. Spencerii* as a test object, and lastly, that the structure, or markings upon it, have been wholly mistaken both by Spencer and myself in consequence of our working with glasses "not capable" of properly resolving the object in question, and hence greatly inferior to those made in London. A few remarks upon each of these points will I trust suffice to correct these errors. To the excellence of the lenses made by Ross and Powell of London, I have always given most willing testimony, and in the only allusion which I have

ever made to them in print, I mentioned their superiority to any European glasses which I had seen, and I only claimed for Spencer that, judging from memory alone, his lenses showed me all that I had previously been able to see on the *Navicula Hippocampus* by the best English achromatic combinations. I made this statement at the very time when I knew that some of the best English microscopes in the country had failed in the hands of their owners, to resolve the *N. Spencerii* which Spencer has mastered; and I did not claim superiority for Spencer's lenses, as I fully believed that these British microscopes would also easily resolve the lines in question, if the peculiar management of light which they require was once hit upon. The correctness of this belief was shown by the first trials which I made with two London microscopes, one made by Ross and the other by Powell, and which was brought to West Point by their owners for the express purpose of trying them upon the *N. Spencerii*, an object which had hitherto baffled their endeavors to resolve it. It was prior to these trials that the letter sent to London "early in the year" was written, in which I stated that the English instruments in the country had failed to resolve the new test, and I feel very confident that in making this statement, I mentioned that up to that time I had not tried the English lenses on this object myself, and also stated the belief I always entertained, that they would resolve it by the aid of proper illumination.

It was certainly not so late in the year as the publication of Mr. Quekett's volume, when I informed the London artists through Mr. Marshall, that by aid of their instruments I had satisfactorily resolved both the longitudinal and transverse lines upon the object, on the first occasion when I had an opportunity of trying their lenses upon it. As I feel sure that the leading London artists will acquit me of all intention to underrate them, I will pass from this subject to the easy task of showing that I had not overrated Spencer's merits, nor the difficulty of the test object which bears his name and which he first resolved. Upon these points I will cite from original documents. Let us see whether the Londoners did not find *their* best instruments apparently incapable of mastering the object which our American back-woodsman had so successfully managed. The first letter which I received from London, informing me of the reception of mounted specimens of the *N. Spencerii* which I sent over to my friends in London, is dated May 20, 1848, and contains the following remark in which I have italicised the acknowledgments so frankly and honorably made.

"The evening I received your package there happened to be a small gathering of our microscopic friends. Your slide with the *Navicula Spencerii* underwent a long examination. *We how-*

ever could make nothing of it. * * * We had some of the finest glasses of Smith, Ross and Powell in our examination, and I am bound to state that at present the result is most unsatisfactory." A postscript to the same letter says, "Since the above was written, I have made several efforts to get at the markings on the *N. Spencerii*, but without success." A subsequent letter dated June 2d, 1848, says, "Still however, I can make nothing of your *N. Spencerii*, although I have employed one of Powell's best glasses with the power of at least 1100."

Knowing by my own experience that the difficulty which my London friends met with, was due to their not employing the much greater obliquity of light which this object requires than any other test previously known, I again wrote to London and sent particular directions concerning the mode of illumination used by Spencer and myself, at the same time expressing my belief that, (as was really the case,) before my letter could reach London the difficulty would be overcome. A letter received by me about the time, from Manchester, England, dated July 27, 1848, is as frank in its acknowledgment of the difficulty of resolving the *N. Spencerii*, as those from London above alluded to. It says, "You have indeed fixed us all now; D——, and myself have given the thing up in despair, and must confess ourselves thoroughly beaten by your Yankee back-woodsman."

The next letter from London announced, as I expected it would, the success of the London microscopists in resolving the test. It is dated July 28, 1848, and says, "I have had an opportunity of submitting your specimens to a very careful examination by the best glasses of Ross, Powell and Smith, our three best makers, and by oblique light we are enabled to resolve them most unmistakeably. But all our efforts to detect the markings by direct light proved fruitless."

From what precedes it appears that from the 2d of May to some time in July, the *Navicula Spencerii* remained in London and not a line, much less dots or perforations, could be seen upon it, although Spencer had resolved two sets of lines upon it by means of his lenses, mounted as he informs me in a *hand tube* and without the aid of achromatic condensers, adjusting screws or even a stage to support the glass slide, a feat, by the way, of the practicability of which I have convinced myself, but which is unparalleled in the history of optics.

It would be unjust to our English friends, if I did not now proceed to show what they developed upon the test in their subsequent trials. And it will presently be shown that Spencer has at least kept pace with them without any previous knowledge of their progress. A letter from London, dated August 18, 1848, says, "the *N. Spencerii* is certainly the most trying test I have yet met with. * * * I have resolved the cross lines upon it *mounted in*

balsam, without any particular management of light beyond what is attainable by the ordinary reflection. By the aid of Ross's $\frac{1}{12}$ th we have unmistakeably brought out these markings on an object mounted dry, and by direct light through the achromatic condensor, and moreover resolved these lines into dots or granulations. I am prepared to say that should you be able to effect this, it will at once stamp Spencer as one of the first makers either in the old or new world. I ought however to observe here, that I think that ere long I shall be enabled to report the resolution of these markings by direct light even in the object mounted in balsam, having pretty nearly accomplished it in the last trial with a friend."

As Spencer long ago demonstrated the existence of both the longitudinal and transverse lines, it followed of course that if both sets could be seen at once, the surface would appear broken into little squares or granulations, precisely as in the much larger and easier test the *N. Hippocampus*. The resolution of these tests mounted *dry* is so much easier than when in balsam, that objects thus mounted are of little value in testing the powers of lenses, although they may answer well when the end is to make out the real structure of the object itself.

I proceed now to notice a discrepancy between Mr. De la Rue's measurements and my own, and to remark upon the existence of the depressions or perforations which he claims to have seen. I have carefully and repeatedly measured by means of Chevalier's camera lucida eye-piece, the distance between the transverse lines or rows of prominences on the adult *Navicula Hippocampus*, and have invariably found it to be about $\frac{1}{40000}$ th of an English inch, and both by estimation and the most careful measurement I could make on an object so minute, the corresponding lines on the *Navicula Spencerii* are, as I stated in this Journal, at least three to five times closer, or from $\frac{1}{120000}$ to $\frac{1}{200000}$ of an inch apart instead of $\frac{1}{40000}$ to $\frac{1}{50000}$ as stated by Mr. De la Rue. To decide whether the appearance of lines on the *N. Spencerii* is due to the allinement of depressions or perforations, or to rows of elevations, or finally to two or more sets of grooves which by their crossing break its surface into granulations, is not an easy task if we confine our attention to so small an object as the *N. Spencerii*, but there can be no doubt that a perfectly analogous structure exists in all the *Naviculaceæ* (connected perhaps with their mysterious organs of locomotion), and the real nature of this structure can best be made out by studying the forms which are most coarsely marked, such as some of the species of *Rhaphoneis*, *Sceptroneis*, *Cocconeis*, *Stauroneis* and the large species of the genus *Navicula*, such as the *N. Baltica* and *N. Hippocampus*. If attention is paid to the direction of the shadows, and the deceptions due to *refracted light* are avoided, I believe that little doubt will be left

upon any mind, that rows of prominences, variously arranged, produce all the appearances of curved or rectilinear striæ seen on these objects, and nothing which I have yet seen on the *Navicula Spencerii* is at variance with the view.

If the lines seen on this species or upon the *N. Hippocampus* are due to rows of pits or perforations, I cannot see why they should not appear equally distinct and strongly marked whether viewed in the longitudinal or transverse directions, a fact which is easily explained by referring the appearances to two sets of grooves differing in depth, forming rows of prominences by their crossing each other. Mr. Spencer agrees with me in believing that all the lines on the *Naviculaceæ* are due to elevations or prominences, and these he states differ very much in form as well as distribution, in different species. I believe these prominences will be found on every species of the *Naviculaceæ* no matter how small, and that any species on which they cannot be made out will be a reproach to the microscope of the age.

I now proceed to give a few extracts from letters received by me from Mr. Spencer, referring to his first examinations of the *N. Spencerii* and his subsequent efforts. They appear to me to be of much interest, as illustrating his determination to reach the very first order of excellence, and an unwillingness to rest satisfied with what might justly have been considered splendid success. In his letter to me, dated Dec. 28, 1847, he informs me of his first reception of the *N. Spencerii* which I had sent to him, telling him that he *must* resolve at least two sets of lines upon it, although I could do nothing with it with my Chevalier lenses. He says, "I find the *Navicula* is striated, as you suppose, longitudinally and transversely. It required all the means and appliances I could command to resolve it. *But I hope the powers I am now making will tell a different story.*" In several subsequent letters he remarks on this test as being *too easy*, although the most difficult one known; and in a letter, dated August 23, 1848, he says, "I hope we shall soon be able to find a much more difficult object." In a letter, dated Nov. 4, 1848, he remarks on the ease with which the lines could be resolved on the objects mounted dry, and adds, "you have done more than I expected your objective would enable you to do, in resolving both systems of lines at once. *My late lenses will do this readily on all the specimens I have tried.* With a $\frac{1}{16}$ nearly completed, I observe the cross lines by central light by my hand tube, I trust to be able ere long to make out both systems by the same illumination." Finally, under date of Nov. 20, 1848, he announces the discovery of the long desired test object, which should exceed the *N. Spencerii* in difficulty. He says, "you will remember my calling your attention to a small shell among the infusoria from guano, and that an examination of the species re-

sulted in failure. I have finally mastered it. The same or a similar form occurs among the infusoria from Greenport, Long Island, which you sent me. The shells are beautifully cross lined, *much finer than in the N. Spencerii*. You will find this object worthy to head the list of tests."

The form alluded to is a species of *Grammatophora*, possibly referable as a *variety* to *G. oceanica*, Ehr., but which I propose to name *G. subtilissima*, on account of its exceedingly minute striæ. It is abundant on our coast, and its markings are so minute that with a glass, which readily resolves the *Navicula Spencerii* mounted in balsam, I cannot detect a trace of lines upon this, and can only satisfy myself of their existence on the specimens mounted dry.

A fuller account of the new test will doubtless soon be furnished by Spencer himself. In the meantime the above hasty notice of it is given, to complete my proof that I have not over-rated the powers of our native artist.

